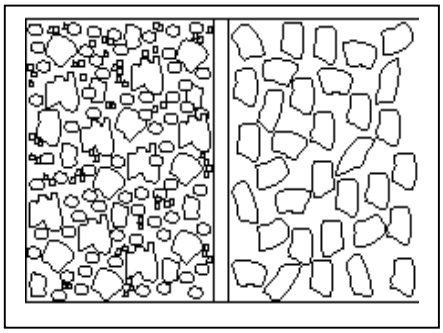
MECHANICAL ANALYSIS OF EXTRACTED AGGREGATE FOP FOR AASHTO T 30



Well- vs. uniformly graded

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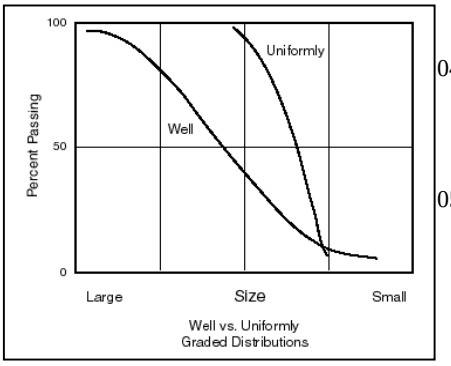
Significance

The amount and gradation of aggregate in bituminous paving mixes are specified by the agency and relate to strength, flexibility, and durability considerations. Mix designs are based on those specifications, as is mix production. To confirm that the amount and gradation of aggregate in the finished product are correct, tests must be conducted. Compliance with the specification will help ensure a good roadway. Non-compliance may result in failure of the roadway. For these reasons, analysis of aggregate in bituminous mixes is extremely important.



Gradation curves

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Scope

This procedure covers mechanical analysis of aggregate recovered from bituminous mix samples in accordance with AASHTO T 30. This FOP utilizes the aggregate recovered from the ignition oven used in AASHTO T 308. AASHTO T 30 was developed for analysis of extracted aggregate and, thus, includes references to extracted bitumen and filter element, which do not apply in this FOP.

Sieve analyses determine the gradation or distribution of aggregate particles within a given sample in order to determine compliance with design and production standards.

Apparatus

Apparatus

- Balance or scale: capacity sufficient for the sample mass, accurate to 0.1 percent of the sample mass or readable to 0.1 g and conforming to AASHTO M 231.
- Sieves
- Mechanical sieve shaker
- Suitable drying equipment (see FOP for AASHTO T 255)
- Containers and utensils – a pan or vessel of a size sufficient to contain the sample covered with water and to permit vigorous agitation without loss of any part of the sample or water.

Sample Sieving

In this procedure it is required to shake the sample over nested sieves. The sieves are selected to furnish information required by specification. Sieves are nested in order of decreasing size from the top to the bottom and the sample, or a portion of the sample, is placed on the top sieve.

Hand shaking

Sieves are shaken in a mechanical shaker for approximately 10 minutes, or the minimum time determined to provide complete separation for the sieve shaker being used.

Time Evaluation

The minimum time requirement should be evaluated for each shaker at least annually, by the following method: Continue shaking for a sufficient period and in such a manner that, after completion, not more than 0.5 percent by mass of the total sample passes any sieve during one minute of continuous hand sieving.

Provide a snug-fitting pan and cover, and hold in a slightly inclined position in one hand. Strike the side of the sieve sharply and with an upward motion against the heel of the other hand at the

rate of about 150 times per minute, turning the sieve about one sixth of a revolution at intervals of about 25 strokes. In determining sufficiency of sieving for sizes larger than 4.75mm (No. 4), limit the material on the sieve to a single layer of particles.

Overload Determination

11 Additional sieves may be necessary to keep from overloading the specified sieves. The sample may also be sieved in increments. For sieves with openings smaller than 4.75mm (No. 4), the mass retained on any sieve shall not exceed 7 kg/m^2 (4 g/in^2) of sieving surface. For sieves with openings 4.75mm (No. 4) and larger, the mass, in kg shall not exceed the product of 2.5 x (sieve opening in mm) x (effective sieving area). See Table 1.

TABLE 1

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Maximum Allowable Mass of Material Retained on a Sieve, g
Nominal Sieve Size, mm (in.)
exact size is smaller see AASHTO T 27

Sieve Size mm (in.)		203 ϕ (8)	305 ϕ (12)	305 x 305 (12 x 12)	350 x 350 (14 x 14)	372 x 580 (16 x 24)
		Sieving Area m^2				
		0.0285	0.0670	0.0929	0.1225	0.2158
90	(3 1/2)	*	15,100	20,900	27,600	48,500
75	(3)	*	12,600	17,400	23,000	40,500
63	(2 1/2)	*	10,600	14,600	19,300	34,000
50	(2)	3600	8400	11,600	15,300	27,000
37.5	(1 1/2)	2700	6300	8700	11,500	20,200
25.0	(1)	1800	4200	5800	7700	13,500
19.0	(3/4)	1400	3200	4400	5800	10,200
16.0	(5/8)	1100	2700	3700	4900	8600
12.5	(1/2)	890	2100	2900	3800	6700
9.5	(3/8)	670	1600	2200	2900	5100
6.3	(1/4)	440	1100	1500	1900	3400
4.75	(No. 4)	330	800	1100	1500	2600
-4.75	(-No. 4)	200	470	0650	1200	1300

Procedure

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1. Using the aggregate sample obtained from the FOP for AAASHTO T 308, determine and record the mass of the sample. This mass shall agree with the mass of the aggregate remaining after ignition (M_f from T 308 within 0.1% of M_f).

2. Nest a sieve, such as a 2.0mm (No. 10), above the 75µm (No. 200) sieve.

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3. Place the test sample in a container and add sufficient water to cover it. Add a detergent, dispersing agent, or other wetting solution to the water to assure a thorough separation of the material finer than the 75µm (No. 200) sieve from the coarser particles. There should be enough wetting agent to produce a small amount of suds when the sample is agitated. Excessive suds may overflow the sieves and carry material away with them.

Separation of material

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4. Agitate vigorously to ensure complete separation of the material finer than 75 µm (No. 200) from coarser particles and bring the fine material into suspension above the coarser material.

5. Immediately pour the wash water containing the suspended and dissolved solids over the nested sieves, being careful not to pour out the coarser particles.

6. Add a second change of water to the sample remaining in the container, agitate, and repeat Step 5. Repeat the operation until the wash water is reasonably clear. Continue washing until the agent is removed.

Pouring suspension through sieves

7. Rinse the material retained on the 75µm (No. 200) sieve until water passing through the sieve is reasonably clear.
8. Remove the upper sieve and rinse the material retained on the 75µm (No.200) sieve until water passing through the sieve is reasonably clear.
9. Return all material retained on the nested sieves to the container by flushing into the washed sample.
10. Dry the washed aggregate to constant mass in accordance with the FOP for AASHTO T 255, and then cool prior to sieving. Record the "dry mass after washing".
11. Select sieves to furnish information required by the specifications. Nest the sieves in order of decreasing size from top to bottom and place the sample, or a portion of the sample, on the top sieve.
12. Place sieves in mechanical shaker and shake for the minimum time determined to provide complete separation for the sieve shaker being used, approximately 10 minutes.

Note 1: Excessive shaking (more than 10 minutes) may result in degradation of the sample.

13. Determine the mass retained on each sieve to the nearest 0.1 g. Ensure that all material trapped in the openings of the sieves are cleaned out and included in the mass retained.

Note 2: Use coarse wire brushes to clean the 600 µm (No. 30) and larger sieves, and soft bristle brushes for smaller sieves.

Small sieve shaker

Brushing sieve

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Calculation

1. The total mass of the material after sieving should check closely with the original mass of sample placed on the sieves (dry mass after washing). When the masses before and after sieving differ by more than 0.2 percent do not use the results for acceptance purposes
2. Divide the masses in the individual sieves by the total dry mass before washing and multiply by 100 to determine the percent retained on and passing each sieve. Calculate the percent retained and passing each sieve to the nearest 0.1%.
3. Apply the Aggregate Correction Factor to the calculated percent passing, as required in the FOP for AASHTO T 308 "Correction Factor" Steps 10 through 12, to obtain the reported percent passing. Report percentages to the nearest 1% except for the percent passing the 75 µm (No. 200) sieve, which shall be reported to the nearest 0.1%.

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Example:

Dry mass of total sample, before washing: 2422.3 g

Dry mass of sample, after washing out the 75 µm (No. 200) minus: 2296.2

Amount of 75 µm (No. 200) minus washed out: 2422.3 – 2296.2 g = 126.1 g

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Gradation on All Screens

Sieve Size mm (in.)	Mass Retained g	Percent Retained	Cumulative Mass Retained	Cum. Percent Retained	Calc'd Percent Passing	Agg. Corr. Factor T-308	Reported Percent Passing
19.0 (3/4)	0.0		0.0	0	100.0		100
12.5 (1/2)	346.9	14.3	346.9	14.3	85.7		86
9.5 (3/8)	207.8	8.6	554.7	22.9	77.1		77
4.75 (No. 4)	625.4	25.8	1180.1	48.7	51.3		51
2.36 (No. 8)	416.2	17.2	1596.3	65.9	34.1		34
01.18 (No. 16)	274.2	11.3	1870.5	77.2	22.8		23
0.600 (No. 30)	152.1	6.3	2022.6	83.5	16.5		16
0.300 (No. 50)	107.1	4.4	2129.7	87.9	12.1		12
0.150 (No. 100)	96.4	4.0	2226.1	91.9	8.1		8
75 µm (No. 200)	63.5	2.6	2289.6	94.5	5.5	-0.6	4.9
Pan	5.7		2295.3				

Check sum: 2296.2 –2295.3 / 2296.2 X 100 = 0.04 % is within the 0.2 percent requirement.

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Report

Results shall be reported on standard forms approved for use by the agency. Depending on the agency, this may include:

- Mass retained on each sieve
- Percent retained on each sieve
- Cumulative mass retained on each sieve
- Cumulative percent retained on each sieve
- Calculated Percent passing each sieve to 0.1%
- Aggregate Correction Factor for each sieve from AASHTO T 308
- Reported Percent passing

Report percentages to the nearest 1 percent except for the percent passing the 75 µm (No. 200) sieve, which shall be reported to the nearest 0.1 percent.

Tips!

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- Do not lose <u>any</u> material when running the test.
- Remember to base calculations on <u>the total mass of the initial dry sample</u>.
- Check calculations, and sieves for damage or plugging, if results look "odd" or if the material suddenly goes out of spec.

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- Save all material for rerunning.

REVIEW QUESTIONS

1. What is the maximum mass that can be retained on a 4.75 mm (No. 4) sieve with a 12" diameter?

2. Describe how sieves should be cleaned.

3. What should be done to protect the 75 µm (No. 200) sieve during washing?

4. Once a washed sample is placed in the oven and dried to a constant mass, what is the next step?

5. For how long should material be sieved on the shaker?

6. How much unexplained sample mass may be lost before you would have to rerun an aggregate sample?

PERFORMANCE EXAM CHECKLIST

MECHANICAL ANALYSIS OF EXTRACTED AGGREGATE FOP FOR AASHTO T 30

Participant Name _____ Exam Date _____

Record the symbols "P" for passing or "F" for failing on each step of the checklist.

Procedure Element	Trial 1	Trial 2
1. Total dry mass determined to 0.1 g	_____	_____
2. Dry mass agrees with sample mass after ignition (M_f) from AASHTO T 308 within 0.1% of M_f?	_____	_____
3. Sample placed in container and covered with water?	_____	_____
4. Wetting agent added?	_____	_____
5. Contents of container agitated vigorously?	_____	_____
6. Wash water poured through proper nest of two sieves?	_____	_____
7. Washing continued until wash water is clear and no wetting agent remaining?	_____	_____
8. Washed material coarser than 75 µm (No. 200) dried to constant mass at 110 ±5°C (230 ±9°F)?	_____	_____
9. Dry mass after washing determined to 0.1 g?	_____	_____
10. Material sieved on specified sieves?	_____	_____
11. Mass of each fraction of aggregate, including minus 75 µm (No. 200), determined and recorded to 0.1 g?	_____	_____
12. Percent passing on each sieve determined correctly to the nearest 0.1%.?	_____	_____
13. Aggregate correction factor applied?	_____	_____
14. Percent passing on each sieve reported correctly to the nearest 1% and nearest 0.1% on the 75 µm (No. 200)?	_____	_____
15. Does summation of sieve masses check total washed dry mass to within 0.2 percent?	_____	_____

Comments: First attempt: Pass ☐ Fail ☐ Second attempt: Pass ☐ Fail ☐

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Examiner Signature _____WAQTC #:_____